Introduction to Machine Learning

Preprocessig in Natural Language Processing

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Outline

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As Always, we need to Preprocess

For example, simply counting words can give you interesting info

- This is known as unigram word count (or word frequency, when normalized).

How do we count words?

- First we need to define what a word is.

This is highly non-trivial for languages without space

- For example Chinese...

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The importance of defining the concept of a word

- For example Is a number a Word?
  - 124366
  - One hundred thousand

In another example, French

- L'ensemble one word or two?
- Google until 2008 could not
  - l'ensemble to match with un ensemble

With German is worse

- Lebensversicherungsgesellschaftsangestellter
- 'life insurance company employee'

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Prepossessing text is called tokenization or text normalization

Sometimes you need to throw away stuff

- e.g., HTML tags – but sometimes they are valuable, UUencoding, etc.

Word boundaries

- White space and punctuations
  - But words like Ph.D., isn't, e-mail, C|net or $19.99 are problematic.

Actually at the end many people use regular expressions for this

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Stop Words

Things with little value

- Common words which would appear to be of little value.
  - e.g. the, a, and, to, be

What is the Intuition

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- You need them for:
  - Phrase queries: “King of Denmark”
  - Various song titles, etc.: “Let it be”, “To be or not to be”
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- Good compression techniques means the space for including stop words in a system is very small
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Case Folding

Reduce all letters to lower case

- It is a good idea to lower the cases

Longstanding Google example

- – Query C.A.T. – #1 result is for "cats" (well, Lolcats) not Caterpillar Inc

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Further Steps

Stemming and Lemmatization

- This is important to encode the numerical meaning of the document!!!

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Stemming

Definition

- Stemming works by cutting of the end or the beginning of the word.
  - By using common prefixes and suffixes...

Classic Algorithm for English

- The Porter's Algorithm

For Example

- e.g., automate(s), automatic, automation all reduced to automat.

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- “for example compressed and compression are both accepted as equivalent to compress.”

Into the following

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Porter's Algorithm

Definition of a Constant

- A consonant in a word is a letter other than A, E, I, O and U, and other than Y preceded by a consonant.

Therefore

- In TOY the consonants are T and Y,
- In SYZYGY they are S, Z, and G.

Therefore

- If a letter is not a consonant it is a vowel

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Simplicity

- A consonant will be denoted by c, a vowel by v

Thus, we have the following

- A list ccc... of length greater than 0 will be denoted by C,
- A list vvv... of length greater than 0 will be denoted by V

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Basic Structures for the Words

CVCV...C
CVCV...V
VCVC...C
VCVC...V

With Final Representation

- $[C](VC)^m[V]$

m is the measure of any word or word part

- The case m = 0 covers the null word.

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Examples

For $m = 0$

- TR, EE, TREE, Y, BY

For $m = 1$

- TROUBLE, OATS, TREES, IVY.

For $m = 2$

- TROUBLES, PRIVATE, OATEN, ORRERY.

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The rules for removing suffix will be of the form

- (condition)$S_1 \rightarrow S_2$

This means that, if a word ends with the suffix S_1

- The stem before S_1 satisfies the given condition S_1 is replaced by S_2.

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We have that

- * S – the stem ends with S (and similarly for the other letters).
- * v * – the stem contains a vowel.
- * d – the stem ends with a double consonant (e.g. -TT, -SS).
- * o – the stem ends cvc, where the second c is not W, X or Y (e.g. -WIL, -HOP).

There are many other

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Recall and Precision

Recall

- The higher the proportion of correct items you require in the selected set (high precision), the fewer of the total correct items you will select (low recall)

Precision

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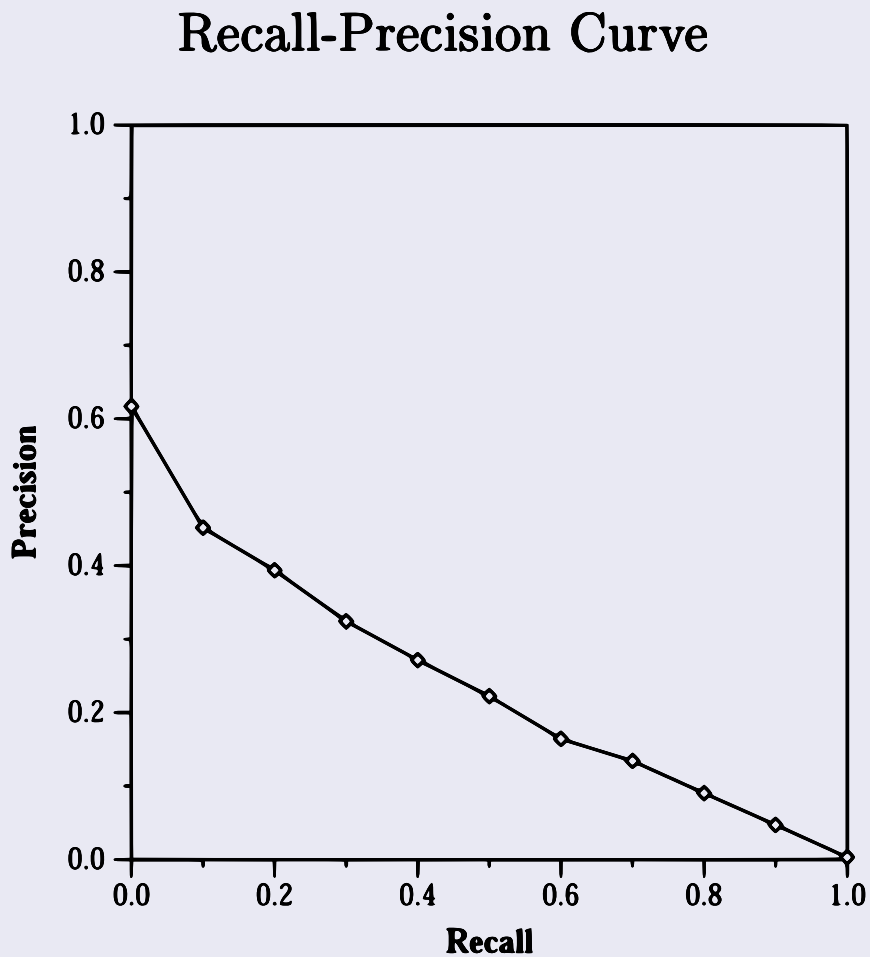
Using Stemmed Documents

And a Sequence of Stemmed Quereies



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What is Lemmatization?

On the other hand

- it takes into consideration the morphological analysis of the words.

The Algorithm needs

- to have detailed dictionaries

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STUDIES

Morphological Information	Lemma
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SUDYING

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Here, a system of rules

- It is used to find the root of the words

Therefore

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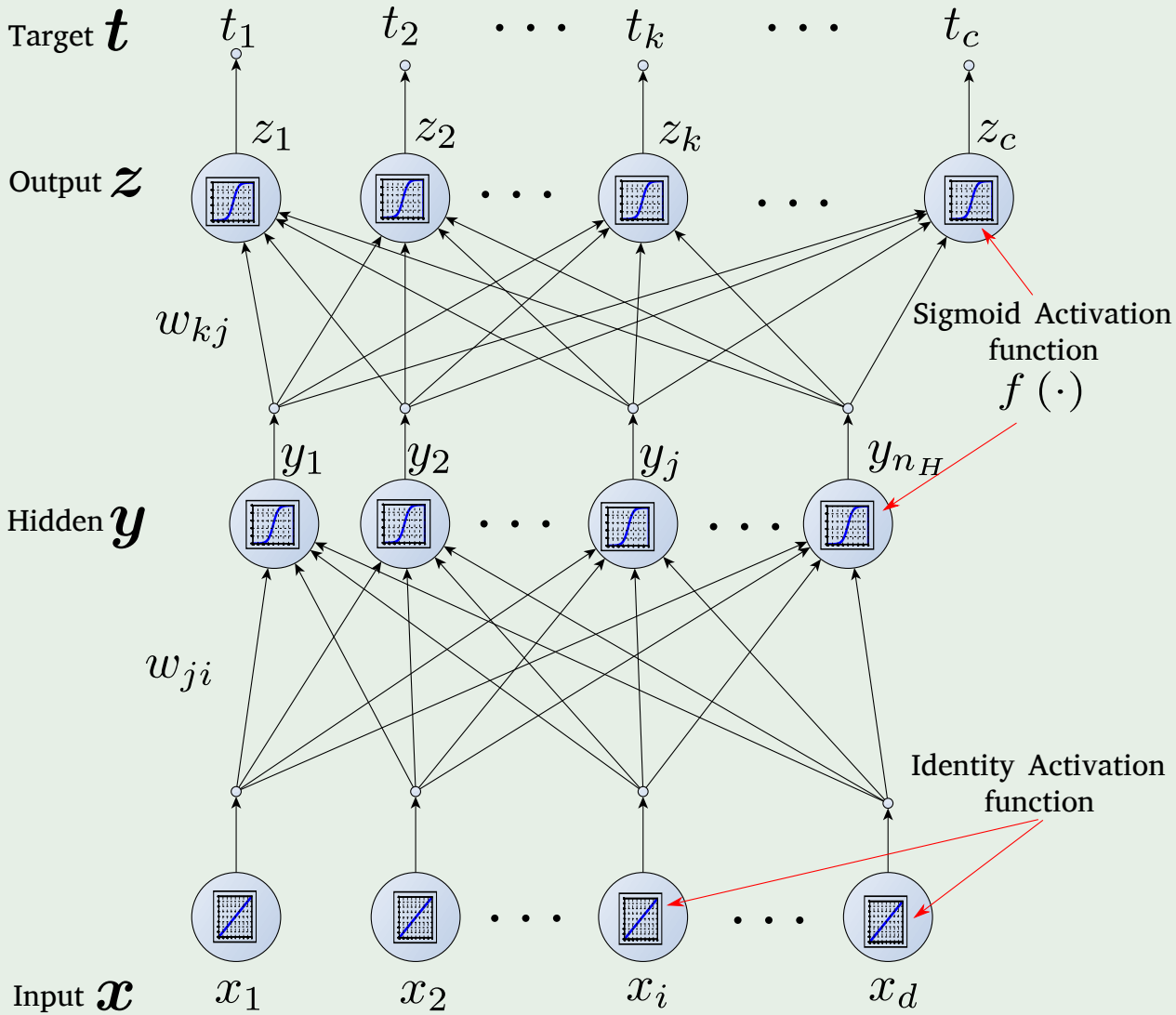
Neural Networks

They are using neural networks right now...



However

It requires to have labeled data

- Again takes time...